Syllabi EVEN SEMESTER

Annexure-I

VI Semester Syllabi – Automobile Engineering

Sr. No.	Course Code	Course Name	L	T	P	Credits
1.	AU3CO14	Vehicle Body Engineering	3	1	2	5
2.	AU3CO15	Vehicle Dynamics	3	1	2	5
3.	AU3CO16	Automotive Refrigeration and Air	3	1	2	5
4.		EL-03	3	0	0	3
5.		EL-04	3	0	0	3
6.	EN3MC01	Self Study(MOOC)	1	0	0	0
7.		OE-02	3	0	0	3
		Total	**19**	**3**	**6**	24
		Total Contact Hours	28			

Program Elective VI-1	**Open Elective - 2 Offered by Mechanical Department**
AU3EL08 Mechanical Vibrations	Advanced Entreprencurship Renewable Sources of Energy Building Maintenance & Repairs Water & Waste Water Engineering Engineering Geology Transportation Engineering Linear Integrated Circuit Data Communication Introduction To System Automation

Program Elective VI-2
AU3EL05 Heat Transfer
AU3EL11 Two &Three Wheeler Technology

Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
AU3CO14	Vehicle Body Engineering	3	1	2	5

UNIT I

Car Body: Classification of vehicle based on body types, Types of car bodies, Integral body construction details: Requirements of body, Loads on the vehicle body: Static load, Acceleration and Braking, car front and rear end structure.

UNIT II

Bus Body Details and Commercial Vehicle Body: Types, Mini bus, single decker, double decker, two level, split level and articulated bus, bus body layout, floor height, engine location, entrance and exit locations, frame construction, double skin construction, Types of body: Flat platform, drop side, fixed side, tipper body, tanker body. Light commercial vehicle body types.

UNIT III

Body Materials: Metal sheets (Steel, Aluminium etc.), plastics, timber, GRP, FRP, Insulating materials, adhesives and sealants. Wind screen, Back light & window Glasses. Difference between toughened glass, sheet glass & laminated glass. Composite materials, anti-corrosion methods, selection of paint and painting process.

UNIT IV

Vehicle Aerodynamics and Body Loads: Vehicle drag and types, various types of forces and moments, effects of forces and moments, side wind, various body optimization techniques and Aerodynamic Aids for Optimization of drag, wind tunnel testing of scale model, component balance to measure forces and moments.

UNIT V

Automobile Body Repair and Servicing: Interior trim and upholstery, Glass and door service, Body insulation and sealing, exterior trim, major and minor body repairs.

Text Books:

1. J.Powloski, Vehicle Body Engineering, Business Books Ltd.,
2. J.C. Giles. Body construction and design, Illiffe Books Butterworth & Co.
3. J. Fenton, Vehicle Body layout and analysis, Mechanical Engg Publication Ltd., London,

Reference Books:

1. J H Smith, "An Introduction to Modern Vehicle Design", Butterworth-Heinemann.
2. H. Heizler, "Advanced Vehicle Technology", Butterworth-, London.
3. J. Fenton, Handbook of Automotive Body and Systems Design, Wiley India.

List of Practicals:

1. To study typical Car - body construction with sketches.
2. To study the construction of typical truck body and draw sketches.

3. To study passenger seat position, requirement and construction by using standard dimension of bus.
4. Study of effect of different shapes, styles and exterior objects on drag force.
5. Calculation of aerodynamic forces and pitching, rolling, yawing moments.
6. Measurement of drag, lift force of a scaled model in wind tunnel.
7. To demonstrate constructional and operational features of mechanical and power window mechanism.
8. Design of intercity bus and prepare a sheet by using any drafting software.
9. Design a Luxury bus structure with seating layout and prepare sheet by using any drafting software.
10. Visit to Automotive body building workshop.

Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
AU3CO15	Vehicle Dynamics	3	1	2	5

UNIT I

Introduction to Vehicle Dynamics: Vehicle Load Distribution – Acceleration and Braking - Brake Force Distribution, Braking Efficiency and Braking Distance - Longitudinal dynamics of a Tractor-Semi Trailer.

UNIT II

Tire and Tire Dynamics: Tire Mechanics – An Introduction Mechanical Properties of Rubber - Slip, Grip and Rolling Resistance - Tire Construction and Force Development - Contact Patch and Contact Pressure Distribution.

UNIT III

Suspensions: Suspension Kinematics, Suspension types, Solid Axles, Independent Suspensions, Anti-Squat and Anti-Pitch Suspension Geometry, Anti-Dive Suspension Geometry, Suspension Dynamics, Multi-body vibration, Body and Wheel hop modes, Invariant points.

UNIT IV

Rollover: Quasi-Static Rollover of a Rigid Vehicle, Quasi-Static Rollover of a Suspended Vehicle, Transient Rollover.

UNIT V

Motorcycle Dynamics: Kinematic structure of motorcycle, geometry of motorcycles, importance of trail, Resistance forces acting on motorcycle (tyre rolling resistance, aerodynamic resistance forces, resistant force caused by slope), Location & height of motor cycle's centre of gravity (C.G), Moments of inertia on Motorcycle.

Text Books

1. H. Pacejka, Tire and vehicle dynamics. Elsevier.
2. W. Jo Yung. Theory of ground vehicles. John Wiley & Sons.
3. N. J. Reaza, Vehicle dynamics: theory and application. Springer

Reference Books

1. R Rajamani, Vehicle Dynamics & control, Springer.
2. W F Milliken and Milliken D L, Race car Vehicle Dynamics, SAE.
3. H.Heister, "Vehicle and Engine Technology",

List of Practicals:

1. Experimental study of mechanism for air flow over different geometry of vehicles.
2. Experimental studies of measurements of drag and lift coefficient for different geometry vehicle using wind tunnel apparatus.

3. To study the effect of tire pressure and temperature on the performance of the tyre.
4. To simulate and study a quarter car models using MBD software.
5. To simulate and understand behavior of sprung / un-sprung mass & lumped mass system MBD software.
6. Finding the stiffness of tire with variation of air pressure.
7. To simulate and study the effect of different conditions on vehicle loading.
8. Study of latest technologies available nowadays in vehicles helping to maintain stability of the vehicle on the road.
9. Study geometry of motorcycles as well as various types of forces faced by the motorcycle & its rider.
10. Study the location & height of Centre of gravity (C.G) of a motorcycle.

Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
AU3CO16	Automotive Refrigeration and Air Conditioning	3	1	2	5

UNIT I

Introduction to Air Conditioning & Refrigeration: Methods of refrigeration. vapour compression refrigeration system, vapor absorption refrigeration system, applications of refrigeration & air conditioning, Automobile air conditioning, isolated vehicles, refrigerated transport vehicles, applications related with very low temperatures. commonly used refrigerants, alternative refrigerants, Eco-friendly refrigerants, refrigerants used in automobile air conditioning.

UNIT II

Study of Psychometric Charts: Psychometric properties, tables/charts, psychometric processes, factors affecting comfort, effective temperature, ventilation requirements.

UNIT III

Load Calculations & Analysis: Design considerations for achieving desired inside/room conditions with respect to prevailing outside/environment conditions. Factors affecting/contributing towards the load on refrigeration & air conditioning systems. Cooling & heating load calculations. Load calculations for automobiles: Effect of air conditioning load on engine performance in terms of loss of available Peak Torque/Power and Fuel consumption.

UNIT IV

Air Distribution Systems: Distribution ducting, sizing, supply / return ducts, type of grills, diffusers, ventilation, air noise level, layout of duct systems for automobiles and their impact on load calculation.

UNIT V

Air Conditioning Service: Air conditioner maintenance & service - removing & replacing Components. Compressor service. Testing, Diagnosis & trouble shooting of air conditioning system. Refrigerant gas charging procedure & Servicing of heater system.

Text Books:

1. Crouse & Anglin, "Automotive Air-Conditioning", – Mc Graw Hill Pub.
2. P. Weiser "Automotive Air-Conditioning",– Reston Publishing Co.
3. P. Lang "Air Conditioning",, C.B.S. Publisher & Distributor, Delhi.

Reference Books:

1. Harris, "Modern Air Conditioning",
2. A. Chhikara, "Automobile Engg", - Satya Prakashan.
3. "American Society of Heating, Refrigeration & Air Conditioning – Fundamentals", ASHRAE Handbook

List of Practical

1. General Study of vapor compression refrigeration system.
2. General Study of Ice Plant.
3. General Study and working of cold storage.
4. General Study Trane Air Condition (Package Type).
5. General Study of Electrolux Refrigeration.
6. General Study One tone Thermax refrigeration unit.
7. General Study of Water cooler.
8. General Study of Psychrometers (Absorption type).
9. General Study of Leak Detectors (Halide Torch).
10. General Study and working of Gas Charging Rig.

Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
AU3EL05	Program Elective-IIHeat Transfer	3	0	0	3

UNIT I

Modes of Heat Transfer: Importance of heat transfer in engineering, basic modes of heat transfer, applications in industry.

UNIT II

Conduction: Mechanism of hear transfer by Conduction, Fourier's three-dimensional differential equation for conduction with heat generation, for unsteady state; in Cartesian co-ordinates. Solution of Fourier's equation for one-dimensional steady state Conduction through isotropic materials of various configurations such as plane wall, cylinder and sphere, composite wall, composite cylinders and composite spheres. Thermal Insulation-insulating materials, Critical thickness of insulation. Extended surfaces. Effectiveness and efficiency of fins.

UNIT III

Convection: Mechanism of heat transfer by convection – Free convection and Forced convection. Hydrodynamic and thermal boundary layers, Convective heat transfer coefficient (film coefficient), Application of dimensional analysis to convective heat transfer. Empirical relations for free convection and forced convection, Physical significance of dimensionless numbers such as Nusselt's Number, Grashoff's Number, Prandtl's Number, Reynolds Number and Stanton's Number. Reynold's analogy between momentum and heat transfer,

UNIT IV

Heat Exchangers: Classification of heat exchangers. Applications, Overall heat transfer coefficient, fouling factor, pressure drop in fluids across heat exchangers. Logarithmic Mean Temperature Difference in parallel flow, counter flow and cross flow heat exchangers, Multi pass heat exchangers. Effectiveness of a heat exchanger- Relation for the effectiveness in terms of Number of Transfer Units.

UNIT V

Radiation: Mechanism of heat transfer by Radiation. Concept of black body and grey body. Emissive power and Emissivity. Basic laws of Radiation: Planck's law, Kirchhoff's law, Stefan- Boltzmann law, Wien's displacement law and Lambert's Cosine law, Intensity of Radiation, shape factors for simple geometrical shapes. Properties of shape factor. Radiosity and Irradiation. Radiation heat exchange between two black bodies. Electrical network analogy.

Text Books

1. J. P. Holman, Heat Transfer, McGraw Hill Companies
2. R. K. Rajput, Heat and Mass Transfer, S. Chand & Company Ltd.
3. M. M. Rathore, Engineering Heat and Mass Transfer, University Science Press

Reference Books

1. Eckert and Drake, Heat and Mass Transfer.
2. Ozisik, Heat Transfer, McGraw Hill,
3. Incropera and Dewitt, Heat Transfer, John Willey and Sons,

Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
AU3EL11	Program Elective-II Two & Three-Wheeler Technology	3	0	0	3

UNIT I

Introduction: Development and history of two & three-wheeler vehicles. Classification & layouts of two wheelers (motorcycles, scooters, mopeds) and Three-wheeler vehicles (by applications – passengers & goods carriage, capacity etc.). Study of technical specification of Two & Three-wheeler vehicles.

UNIT II

Transmission Systems: Clutch – special requirements, different types used in two & three wheelers. Need of primary reduction, selection of transmission - gear box, gear shift mechanism, Chain OR belt drive system for transmission of torque to drive wheels, automatic transmission (Continuously Variable Transmission - CVT, Epicyclic gear train), arrangement of final drive & differential for three-Wheeler.

UNIT III

Suspension & Steering: Front suspension system – shock absorber construction and working principle. Rear suspension system – Mono type suspension. Steering Handle bar on two-wheeler / three-wheeler vehicles.

UNIT IV

Instrumentation & Controls: Two-wheeler / three-wheeler panel meters & controls. All types Switches, Indicators, warnings indicators / buzzers & actuating levers on steering handle bar. Starting / Ignition and steering lock key switch on Steering Handle Shaft.

UNIT V

Electrical Systems & Instruments: Battery specifications, charging system, Lighting (front & rear), Ignition key switch, Horn, Side Signalling, Instruments & Indicators.

Text Books

1. N. Steed, "The Motor Vehicle", McGraw Hill Book Co. Ltd., New Delhi
2. S. Herrmann, "The Motor Vehicle", Asia Publishing House, Bombay.
3. "Two stroke Motor Cycles", Staff & Motor Cycles, London Ilefe Books.

Reference Books

1. Service Manual, Jeep Utility Vehicles, Villys Motors, Ioc., USA.
2. P. E Irving.., "Motor Cycle Engineering", Temple Press Book, London.
3. "The Cycle Motor Manual", - Temple Press Limited , London.

Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
AU3EL08	Program Elective -IMechanical Vibrations	3	0	0	3

UNIT I

Basics Of Vibration: Basic concepts of vibrations, causes and effects of vibrations, applicatons of vibration Classification of Vibrations, Basic elements of vibratory system - spring, mass, damper. Degree of freedom, Mathematical modeling of physical systems, Formulation of differential equations by various principles and determination of natural frequency of undamped SDOF vibratory system

UNIT II

FreeDampedVibration : Damping and its Classification- viscous, coulomb, slip and structural damping, derivation of differential equation under damped, critically damped and over damped SDOF vibratory system, Logarithmic decrement. Derivation for coulomb's damping and rate of decay of amplitude.

UNIT III

Forced Vibration System: Forced single degree of freedom vibration system, analysis of linear and torsional vibratory systems subjected to harmonic force, vector representation of forces in the system, vibration isolation and transmissibility ratio for systems subjected to excitation of support, concept of absolute and relative motion.

UNIT IV

Two and Multi Degree of Freedom System : Derivation of governing equations, natural frequencies and mode shapes for 2- DOF vibratory system, concept of semidefinite system and coordinate coupling, Determination of natural frequency of multi degree of freedom system using – matrix method, method of Influence coefficients and Rayleigh's method

UNIT V

Vibration Measuring Instruments: Principle of seismic instruments- Vibrometer, accelerometer, sensors used in vibration measurement. Introduction to FFT analyser, Introduction to condition Monitoring and Fault diagnosis.

Text Books

1. S. S. Rao, Mechanical Vibrations, Pearson Education,
2. A. G.Ambekar, Mechanical Vibrations, PHI Learning,
3. G. K. Grover, Mechanical Vibrations, Nem Chand & Bros,

Reference Books

1. V. Rao Dukkipati and J. Srinivas, Mechanical Vibrations, Second Edition, PHI Learning
2. G. Kelly, Mechanical Vibrations, Schaum's outline series, Tata McGraw Hill, Special Edition,
3.W.T. Thomson, Theory of vibrations with applications, CBS Publishers, Delhi.

Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
EN3MC01	Open Learning course	1	0	0	0

Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
OE00035	Open Elective -IIAdvanced Entrepreneurship	3	0	0	3

UNIT I

Orientation To Growth: Getting Ready for Growth, Why growth stage is different compared to startup phase, Why Product-Market fit is not enough, Case study, To assess readiness for growth, To chart a growth path

UNIT II

Customers: Expanding Customer Base-Revisit your business model and develop few variants (more business model types), Identify additional customer segments that your solution can address, Evaluate business models for the new customer segments, Re-look at the Problem Statement (can you expand the scope and scalability of your business by repositioning your problem statement?), Explore additional ways to monetize

UNIT III

Traction: Scaling-How to gain traction beyond early customers, Defining traction (in quantifiable terms) and identifying the most important metrics to measure traction, Calculate cost of new customer acquisition, Estimate your customer lifetime value (LTV), Identifying waste in your operations and focusing your team on what is important for traction

Channels and Strategy- The Bullseye framework Identify Channels using Bulls Eye Framework Measuring the effectiveness of selected channels Budgeting and planning

UNIT IV

Money:Growing Revenues-Stabilizing key revenue streams, Developing additional revenue streams (licensing, franchising), Exploring new channels and partnerships

Sales Planning-Understanding why customers buy and how buying decisions are made; Listening skills, Sales planning, setting targets, Unique Sales Proposition (USP); Art of the sales pitch (focus on customer's needs, not on product features) Follow-up and closing a sale; Asking for the sale

Strengthening Sales-Building a professional sales team, Sales compensation and incentives, Sales planning, setting targets

Improving Margins-Testing price elasticity, Optimizing costs and operational expenses, Advanced concepts of unit costing

Financial Modeling-Financial modeling of your venture's growth, Analyzing competitor and peer's financial models

UNIT V

Support: Legal-Overview of legal issues and their impact on entrepreneurs, Importance of getting professional help (legal and accounting), Importance of being compliant and keeping proper documentation, Patents and Intellectual property, Trademarks

Mentors, Advisors, and Experts-The importance of a Mentor and how to find one, Role of business advisors and experts for specific targets in your growth plan

Text Books

1. A. Mathur, Entrepreneurship, Taxmann,
2. V. Desai,Fundamentals of Entrepreneurship & small business management, Himalaya Publishing House.
3. Entrepreneurial Development by S.S. Khanka, S. Chand Publication.

Reference Books

1. S.Shane, A General theory of entrepreneurship: The individual opportunity nexus, Edward Elgar Publication.
2. J. A. Timmons & S. Spinelli, New Venture Creation: Entrepreneurship for the 21st century , McGraw-Hill.
3. R.D Hisrich and M Peters, Entrepreneurship, McGraw-Hill.

Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
OE00036	Open Elective -IIRenewable Sources of Energy	3	0	0	3

UNIT-I

Introduction: Causes of Energy Scarcity, Solution to Energy Scarcity, Factors Affecting Energy Resource Development, Energy Resources and Classification, Renewable Energy – Worldwide Renewable Energy Availability, Renewable Energy in India. Energy from Sun:Sun- earth Geometric Relationship, Layer of the Sun, Earth – Sun Angles and their Relationships, Solar Energy Reaching the Earth's Surface, Solar Thermal Energy Applications

UNIT-II

Solar Energy Collectors: Types of Solar Collectors, Configurations of Certain Practical Solar Thermal Collectors, Material Aspects of Solar Collectors, Concentrating Collectors, Parabolic Dish , Solar Water Heating Systems, Passive Solar Water Heating Systems, Applications of Solar Water Heating Systems, Active Solar Space Cooling, Solar Air Heating, Solar Dryers, Crop Drying, Solar Cookers, Solar pond. Solar Cells: Components of Solar Cell System, Elements of Silicon Solar Cell, Solar Cell materials, Practical Solar Cells, Photovoltaic Panels, Applications of Solar Cell Systems.

UNIT-III

Wind Energy: Windmills, Wind Turbines, Wind Resources, Wind Turbine Site Selection. **Geothermal Energy**: Geothermal Systems, Classifications, Geothermal Resource Utilization, Resource Exploration, Geothermal Based Electric Power Generation,Associated Problems, environmental Effects.

Solid waste and Agricultural Refuse: Waste is Wealth, Key Issues, Waste Recovery Management Scheme, Advantages and Disadvantages of Waste Recycling, Sources and Types of Waste,Recycling of Plastics.

UNIT-IV

Biomass Energy:Biomass Production, Energy Plantation,Biomass Gasification, Updraft, Downdraft and Cross-draft Gasifiers, Fluidized Bed Gasification, Use of Biomass Gasifier, Gasifier Biomass Feed Characteristics, Applications of Biomass Gasifier, Cooling and Cleaning of Gasifiers. **Biogas Energy**: Introduction, Biogas and its Composition, Anaerobic Digestion, Biogas Production, Benefits of Biogas, Factors Affecting the Selection of a Particular Model of a Biogas Plant, Biogas Plant Feeds and their Characteristics.

UNIT-V

Ocean Thermal Energy: Introduction,Principles of Ocean Thermal Energy Conversion (OTEC), Ocean Thermal Energy Conversion plants, Basic Rankine Cycle and its Working, Closed Cycle, Open Cycle and Hybrid Cycle, Carnot Cycle, Application of

OTEC in Addition to Produce Electricity, Advantages, Disadvantages and Benefits of OTEC

Tidal Energy: Introduction, Tidal Energy Resource, Tidal Energy Availability, Tidal Power Generation in India

Text Books

1. Kothari, Singal & Rajan; Renewable Energy Sources and Emerging Technologies, PHI
2. B.H Khan, Non Conventional Energy, TMH.
3. Sukhatme and Nayak, Solar Energy, Principles of Thermal Collection and Storage, TMH.

Reference Books

1. K. Rao, Energy Resources, Conventional & Non-Conventional, BSP Publication.
2. C.S.Solanki, Solar Photovoltaics: Fundamental, technologies and Application, PHI
3. A.Tasnoem and SA Abbasi; Renewable Energy Sources; PHI Learning.